

Name: _____

Virtual Daphnia Heart Rate – AP Lab 10 Part C

Click through the Virtual Lab at the following website and answer the questions below.

http://www.phschool.com/science/biology_place/labbench/lab10/concepts2.html

1. State a hypothesis relating metabolic activity to the heart rate of ectothermic animals.
2. Relate the increase in metabolic activity at high temperatures to enzyme activity and thermal energy.
3. Define Q_{10} . What does it mean if an organism has a Q_{10} of 4?
4. Complete the graph for the Daphnia heart rate at the three temperatures.

Temperature (°C)	Heart Rate (beats per minute)
10	
20	
30	

5. Take the self quiz and write the correct answers below.
 - Which of the following organisms would show the greatest fluctuation in body temperature hour by hour?

 - What is the relationship between metabolic rate and body temperature in *Daphnia*?

 - If $Q_{10} = 2$, then an enzymatic reaction that takes place at a given rate at 5°C would take place approximately how many times faster at 25°C?

 - Which of the following experimental conditions would be most life-threatening for an ectothermic organism?

Lab 10 C Heart Rate and Temperature

The Daphnia lab was conducted and the data that they got reported below:

Heart Rate in Daphnia at Different Temperatures		
Reading	Temperature (° C)	Heart Rate (beats/min.)
1	5	108
2	10	152
3	15	211
4	20	290

1. Graph the data above.

2. Answer the analysis questions below.

- A) Why does temperature affect heart rate in ectothermic organisms?
- B) Discuss what results you might obtain if you repeated this experiment using an endothermic organism.
- C) Describe at least four ways an ectothermic organism's behavior helps it regulate its temperature.

3. Answer the following questions as well.

The Q_{10} of an ectothermic organism is the measure of the increase in metabolic activity (reflected by heart rate in this example), due to a 10 degree increase in temperature. For example a Q_{10} of 3 means that the heart rate will triple when the temperature increases by 10 degrees.

1. Calculate the Q_{10} of daphnia between 5 and 15 degrees, and between 10 and 20 degrees using the following formula:
 - a. $Q_{10} = \text{Rate at higher temperature} / \text{Rate at lower temperature}$.
 - b. Take the average of these two to estimate the overall Q_{10} .
 - c. Show your work.
2. Based on your Q_{10} calculation in question 1 above, what should the heart rate of the daphnia be at a temperature of 30° C? Show your work.
3. Calculate the Q_{10} of germinating pea seeds. Use the rate of respiration as an indicator of metabolic activity.

The rate of cellular respiration at 25 degrees was 0.012 ml O_2 consumed/min

The rate of cellular respiration at 10 degrees was 0.005 ml O_2 consumed/min

The formula you have to use this time is:

$$Q_{10} = [k_2/k_1]^{(10/t_2-t_1)}$$

Where:

t_2 = higher temperature

t_1 = lower temperature

k_2 = rate at temperature t_2

k_1 = rate at temperature t_1

Once you have calculated the Q_{10} for the germinating seeds compare their Q_{10} to that of the daphnia. Explain the similarities or differences between these values.